REMARKS

Introduction

Independent claims 60 (apparatus) and 64 (method) fully comply with Section 112, overcome the art of record and are supported by the inventors' Rule 1.131 Declaration. Reconsideration and allowance are therefore respectfully requested.

Claim 60 is similar to claim 38 submitted with the amendment filed on October 27, 2008, with additional clarification of the specific GNSS signal-blocking obstruction problem solved by the present invention. No new matter has been added and no new issues are raised. None of the prior art references, taken singly or in combination, solves the problem of multiple antennas receiving partial satellite ranging signal sets, which are combined for computation of a position solution for a single point on the structure using fixed and known distances and geometries, orientation of the structure and simultaneous signal processing from multiple antennas, all on a slow-moving structure including the signal-blocking obstruction. Method claim 64 is similar to claim 60 and should also be allowed.

Prior Art Distinguished

Claims 60 and 64 respectively claim a system and method for determining the GNSS-defined position of a single point on a structure including a satellite-blocking obstruction. The antennas and a single point are in fixed distance and geometry relations relative to each other and the structure. Each antenna "sees" three or fewer satellites and collectively they see at least four satellites. A position solution would therefore not be possible with the signals from only one antenna. However, with the other claimed features of an orientation device and fixed distance/geometry relationships, a complete solution for the single point is possible.

Dizchavez 6,191,733 discloses equipment with two GPS antennas for determining the position of critical working components, such as a shovel bucket 16, based on sensors for determining the working components' positions relative to a car

body 12. However, it does not disclose a signal-blocking obstruction. In fact, the antennas 18, 20 are mounted on the roof of the vehicle body 12 (3:20-24), i.e. separated from the shovel bucket 16 (Fig. 1). In fact, nowhere does the reference suggests that the shovel bucket 16 could block an antenna from receiving GNSS signals. On the contrary, the antenna locations (on the roof of the vehicle body 12) would maximize their unobstructed views of the GNSS satellite constellations. Moreover, shovel bucket position and orientation are determined by separate sensors. (3:60-4:4). Moreover, the Dizchavez point of interest (e.g., on the shovel bucket 16) moves relative to the car body 12 and therefore is not a single point with a fixed distance and geometry relative to the antennas and the structure, as presently claimed. Dizchavez is utilizing a full complement of satellite signals at each antenna, and fails to address the partially-blocked satellite problem for which the applicants' claimed invention provides a solution.

Wilson 6,292,132 (Figure 2) shows GPS antennas and receivers in a fixed distance/geometry relation on a single vehicle for maintaining position information when fewer than four satellites are visible. The system calculates "cone angles" between the antenna-processor pairs sharing a common clock, which are used along with an initial position fix for combining with sensor-generated (e.g., steering wheel input) information for estimating a position by "dead reckoning." However, the antenna-processor pairs see the same satellite sets and the system is essentially relative positioning based on the initial point. By contrast, the applicants claimed antennas collectively "see" a complete four-satellite set, although each antenna only sees a subset due to the satellite-blocking obstruction, and use an orientation device for computing a position solution for the single point of interest. Hence the present invention enables a complete position/attitude solution without the need of inertial navigation devices, which Wilson relies on for dead reckoning navigation.

Rorabaugh 6,922,635 (Figure 4) shows an unconstrained system of independent mobile units 101A and 101B on opposite sides of a blocking structure 115 whereby each sees a different subset of satellites. Positioning the Rorabaugh mobile units is relative, i.e. relative to others of a wirelessly networked group of receivers mounted on respective mobile units. Thus, the fixed distance/geometry, slow-moving

object orientation and common/synchronized clock(s) features of applicants' claimed invention are not present. The Rorabaugh system would therefore not provide an attitude/position solution locating the single point on the structure, with each receiver seeing three satellites but collectively forming a complete position solution.

Hanseder 6,253,160 discloses a machine control with antennas and receivers for RTK tool positioning control. However, the purpose of the second antenna and receiver are for calibrating the tool. Figure 2 shows temporary placement of the antenna 13B on the tool (bucket) for calibration relative to the excavator 1. The present invention is distinguished by several claimed features, including the fixed distance/geometry, slow-moving object orientation, common/synchronized clock(s) and other distinguishing features.

Dooley 6,618,671 shows a method of determining the relative position of a mobile unit, such as a cell phone. However, it does not involve a structure with multiple fixed-relation antennas for determining a point position.

Toda et al. 6,611,228 show carrier phase-based relative positioning for a marine vessel (Figures 8A-C) with antennas positioned in constrained relations on opposite sides of the vessel for providing its attitude and relative position. However, there is no disclosure of the antennas seeing partial subsets of the available satellites because of a signal-blocking obstruction, nor an orientation device providing information for computing a position solution in unison with positioning information from the receivers.

Tang et al. 5,933,110 show a ship docking system using a pair of wing-mounted, constrained GPS receivers for calculating position, velocity and heading, particularly for a ship in a docking maneuver. However, there is no disclosure of an antenna-blocking obstruction whereby the GPS receivers use measurements from partial subsets of the available GPS satellites in combination with the other claimed position-determining features.

Section 112 and Prior Invention (Rule 1.131 Declaration)

Appendix A is a table showing support for claim 60 (method claim 64 is similar) with references to the original specification, and the prior invention of the claimed subject matter established by the inventors' Rule 1.131 declarations submitted with the amendment dated April 28, 2008. A Rule 1.131 declaration is not required to be fully commensurate with a rejected claim in order to overcome a reference. See, MPEP § 715.02 and *In re Spiller*, 500 F.2d 1170, 182 USPQ 614 (CCPA 1974). For example, the disclosure attachment to the Rule 1.131 declarations does not explicitly describe an orientation device, but does refer to the system determining "… the bearing of the other receiver." (Paragraph 2, lines 17-18) Bearings are determined by orientation devices, such as compasses. Therefore, the disclosure attachment dated January 28, 2003 is effective for showing possession of the complete invention as presently claimed.

Conclusion

Based on the foregoing, claims 60 and 64, which are the only independent claims, distinguish over the references of record singly and in combination. The novel and unobvious invention involves antennas in fixed distance/geometry relation on a structure, with the structure including a satellite-blocking obstruction whereby each antenna only sees a subset of the available satellites. The claimed invention develops a position solution for a single point using fewer GNSS measurements than would otherwise be required using such fixed relations and an orientation device.

As noted above, the prior art includes multiple, constrained antennas for attitude determination, and multiple unconstrained antennas in blocked-satellite environments. The environments in which these prior art systems operate include machine control, ship docking and vehicle navigation/guidance, including networks of separate vehicles. However, none of the prior art references, taken singly or in combination, would solve the problems of constrained antennas in a blocked-satellite environment with the fixed distance/geometry relations and other claimed features. For

example, the applicants' January 28, 2003 disclosure provides an example where each receiver sees a subset of three satellites due to an intervening wall, crane, etc., but a position solution is nevertheless possible because of the fixed distance/geometry relation, the orientation device other claimed features.

Based on the foregoing, this application is in condition for allowance and notice to this effect is respectfully requested.

The Commissioner is authorized to charge any excess fees, or credit any overpayments to Deposit Account No. 50-3424. The examiner is invited to contact the undersigned by telephone if prosecution of this application can be expedited thereby.

Respectfully Submitted,

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DATE

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SPECIFICATION AND PRIOR INVENTION DISCLOSURE SUPPORT FOR CLAIM 60

Claim 60 (new)	Specification Support US 2004/0212533	Whitehead Disclosure Date-stamped 1/28/03, Attachment A to Whitehead Rule 131 Declaration.
System for determining GNSS- defined position of single point fixedly positioned on slow-moving, mobile structure including GNSS signal-blocking obstruction:	[0056] lines 1-7 and 10-17.	Instead of a wall, this [structure] could be a ship with a large crane obstructing the common view to all satellites. (¶ 2, lines 18-19) For example, one receiver on one side of a wall sees 3 satellites, and another on another side of the wall sees 3 satellites. (¶ 2, lines 12-14)
master and slave GNSS receivers;	Figs.1 and 2, #12 and #14 respectively.	Situation where one or more of the GPS receivers are only seeing a small subset of the available satellites. (¶ 2, lines 10-11)
master and slave antennas connected to said master and slave receivers respectively and mounted in fixed relation with known geometry and distances relative to each other and to single point; master and slave antennas mounted on opposite sides of structure below signal-blocking obstruction;	[0056] lines 1-4 and 20-22. [0056] line 14.	The location of each receiver is constrained relative to the other receiver by a fixed distance and/or geometry and/or common clock. (¶ 2, lines 2-3)
common or synchronized clock(s) connected to said receivers;	[0031] lines 20-26.	The location of each receiver is constrained relative to the other receiver by a fixed distance and/or geometry

		and/or common clock. (¶ 2, lines 2-3)
orientation device mounted on structure for determining structure orientation;	[0056] lines 17-18.	Receivers use common clock separated by known distance so six measurements (e.g., three at each antenna) include two for the bearing of the other receiver. (¶ 2, lines 2-3 and 15-18)
computing means for determining GNSS-defined position of single point using: (1) GNSS signals received by master and slave receivers, obstruction blocking GNSS signals whereby each antenna receives signals from no more than three satellites and collectively said antennas receive signals from at least four satellites; (2) known relative orientation and fixed distances and geometry of antennas relative to each other and to structure; (3) known relative orientation and fixed distances and geometry of single point relative to antennas and to structure; and (4) orientation of structure based on input from the orientation device.	[0056] lines 1-3. [0056] lines 5-7. [0056] lines 3-4. [0056] lines 3-4 and 20-22. [0056] lines 17-20.	For example, one receiver on one side of a wall [obstruction] sees 3 satellites, and another on another side of the wall [obstruction] sees a different subset of 3 satellites. (¶ 2, lines 12-14 and 18-19) Receivers use common clock separated by known distance so six measurements (e.g., three at each antenna) include two for the bearing of the other receiver. (¶ 2, lines 2-3 and 15-18)